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The Digestibility and some Associated Nutritional Parameters of a New Wheat Cultivar (Seri 82-Aus) and Barley (Gilbert) for Sheep

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ABSTRACT: The nutritional value of a new wheat cultivar, Seri 82-Aus, was compared to that of barley(Gilbert). Both grains were fed as part of a formulated feedlot ration to sheep. Digestibility of dry matter, organic matter, neutral detergent fibre and starch was similar for both grains with an estimated metabolisable energy content of 12.5-13.0 and 13.2-13.5 MJME/kgDM for barley and wheat respectively. The microbial protein production was similar for both grain sources as was the VFA pattern with a characteristic high propionate molar proportion. It was concluded that the new wheat cultivar Seri 82-Aus was similar in nutritional value to Gilbert barley and literature values for wheat.

Key words: Wheat, Barley, Digestion, Ruminants.

INTRODUCTION

Barley is the most common feed ingredient in feedlot diets for cattle and sheep in Australia and is also widely used in supplementing animals at pasture. It is has a high metabolisable energy content (M/D 12.5-14.2 MJME/kg DM). Wheat is less commonly used for ruminants and is often a minor ingredient of rations. Recently the value of wheat and barley have been reviewed (Barneveld, 1999; Bird *et al* 1999; Rowe *et al* 1999). The wheat cultivar, Seri 82-Aus has recently been selected as a high yielding feed wheat cultivar within the Northern Wheat Program. The current experiment measures the digestibility and other nutritional characteristics of Seri wheat to ensure they agree with the literature and that there is nothing unusual about the wheat. Gilbert barley is used as a comparison.

MATERIALS AND METHODS

Gilbert barley and Seri 82-Aus wheat were grown in adjacent unreplicated blocks (120m by 24m) at Roma with fertiliser inputs of 59, 8.2, 0.9 and 1 kg/ha of N, P, S and Zn, respectively. Approximately 240 kg of grain was harvested from each block.

A feedlot diet for sheep was formulated (Table 1) based on a commercial ration formulation (FEEDMANIA R. Elliott, Roche pers. comm.). This comprised a chopped tropical grass hay (ca. 30%) and wheat or barley, with premix and minerals the remainder. Both grains were rolled and minerals and premix added and mixed daily for each animal. Hay and grain were fed mixed in the same feed bin. The composition of the grain and hay is seen in Table 1.

The ration was fed at a level of 19.1g DM/kg W calculated to be above maintenance but with little refusal. Ten wethers (5 on each grain, mean liveweight 37.4∀2.0(SE) kg) were allocated randomly to each of the 2 grains (5/treatment). A 2 week adjustment period whereby animals were moved gradually from a hay diet to the grain mix diet occurred and then animals were held at that level for a 7d preliminary period and then a 7d collection of refusals, faeces and urine with metabolism cages using faecal and urine separators. Subsamples of faeces, urine, feed and refusals were taken for DM and chemical analysis. Urine was collected into 10% sulphuric acid using a sufficient volume to keep pH<3. The bulked sample at the end of the week was subsampled for N analysis (as is) and purines (5mls urine + 44mls buffer + 1ml allopurinol). Samples were stored frozen. Faeces were oven dried for DM and another subsample freeze dried for chemical analysis. Feed and refusals were oven dried. All samples were ground (1mm) and stored. The refusals were separated into grain and hay and analysed separately. At the end of the 7d collection, rumen fluid was taken by stomach tubing at 3 and 24 hours after feed was offered. pH was adjusted to ca.3 and samples stored frozen until analysis for rumen ammonia and VFA.

DM was done by oven drying at 60°C until dry, OM by ashing at 500°C for 6hrs, N by the Leco CNS, NDF by the Van Soest method (starch was removed from grain samples by an amylase enzyme prior to detergent extraction) and starch by Mc Cleary *et al*. (1997). Purines were determined by a HPLC procedure with an extraction column (modified Balcells procedure) and microbial protein production calculated by purine excretion in the urine (Chen and Gomes, 1992). Rumen ammonia was measured by titration using sodium tetraborate as the alkali agent and an automatic titrator. VFA was measured by gas chromatography. *In vitro* fermentability and enzyme digestibility of starch was measured according to Bird *et al*., (1999).

Results were analysed as a randomised block design with 2 treatments (wheat or barley), 5 replications/treatment and by ANOVA.

RESULTS

Intake, digestibility, N balance, microbial protein production, rumen ammonia and rumen VFA are given in Tables 2 and 3. One animal allocated to the barley treatment had large refusals during the collection period and its results were discarded and a missing plot used in the statistical analysis. Three other animals had small refusals of grain. Barley comprised 66.2% of the total DM intake and wheat 71.9% when the refusals of grain and hay were accounted for. The pH of urine collected on 2d prior to the 7d collection, and without added acid, was 8.6∀0.06 and 8.6∀0.04 for the barley and wheat diets respectively.

There were no statistical differences between the 2 grain treatments in any of the parameters except for rumen ammonia at 3 hrs and isobutyric and isovaleric molar proportions at 24 hrs. The *in vitro* enzyme digestibility of barley was 35.6% and of wheat was 37.5%. The *in vitro* fermenatability was 82.7% and 71.5% for barley and wheat respectively.

Table 1. Composition of the ration fed to sheep (g/kg DM). DM, dry matter; OM, organic matter; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre; Starch

	DM as fed	OM	CP	NDF	ADF	Starch
Pangola hay	285	945	54	724	410	not detected
Barley	649	927	149	214	66	540
or Wheat	649	981	160	164	39	668
Minerals & Premix	66	-	-	-		

Minerals and Premix (g/kg)	
Bentonite	350
Sodium bicarbonate	105
Dicalcium phosphate	105
Limestone	350
Bovatec	3.5
Colborne-Dawes Stud premix	16.5
Salt	70

DISCUSSION

The major factor determining nutritive value is the digestibility of the diet from which M/D is calculated for ration formulation. The mean OM digestibility of the diets was similar at 75% and 77% (Table 2). If it is assumed that the OM digestibility of pangola grass hay is 50-55% (from a number of experiments with this hay from this laboratory) then the estimated OM digestibility of barley is 85-88% and wheat is 85-87%. These lead to estimates of M/D of 12.5-13.0 and 13.2-13.5 MJME/kgDM for barley and wheat respectively assuming 15.83 MJME/kgDOM (Beever *et al* 1986) The values indicate that the Seri wheat cultivar is of similar nutritional value to Gilbert barley. The above values for Seri 82-Aus wheat and Gilbert barley are similar to values for wheat and barley collated by Barneveld (1999) and Rowe *et al*., (1999). There were no ill effects of feeding wheat at the current level of feeding and at ca 70% inclusion.

Hay made up ca 63% of the NDF consumed by sheep and the total NDF digestibility at 60% and 55% for barley and wheat, respectively, was expected. The *in vitro* fermentability of wheat was in the mid range for wheat (S.Bird pers. comm.). The *in vitro* enzyme digestibility of both grains was in the low range of values collated for these grains by Bird *et al*., (1999) which may be indicative of poor small intestinal digestion of the starch. However, the *in vivo* starch digestion over the whole tract was high (98%) for both grain diets.

The levels of rumen ammonia at 74-112 mg ammonia N /L were low given the crude protein content of the diet, but probably reflect the high digestibility of the diet and its capture of rumen degradable N. No urea was included in the diet based on the high N content of the grains used (Table 1). The microbial protein production was similar but with a large SE (Table 2). The efficiency of microbial CP (MCP), estimated at 87 and 92 g MCP/kg DOM for barley and wheat, respectively, was low and below the accepted values for feedlot rations of 130g MCP/kg DOM (NRC 1996). The results indicate no difference between the grains in MCP production which might be expected if wheat is digested to a lesser extent in the rumen than barley (Rowe *et al*., 1999).

Table 2. The intake (g/d), dry matter digestibility (DMD%), organic matter digestibility (OMD%), neutral detergent fibre digestibility (NDF%), crude protein digestibility (CPD%), starch digestibility (SD%), N balance (NB g/d) and microbial protein production (MCP g/kgDOM) by sheep consuming a barley based or wheat based feedlot ration.

	Barley	SE	Wheat	SE
Intake g/d	664	37.9	593	35.3
DMD%	71.8	0.67	73.3	1.18
OMD%	75.1	0.86	77.0	1.06
NDFD%	59.7	2.33	54.9	2.31
CPD%	69.8	2.20	70.0	1.54
SD%	98.0	0.18	98.3	0.23
NB g/d	1.41	0.622	1.81	0.708
MCP g/kgDOM	86.8	17.51	92.4	16.57

The low value might indicate a shortage of RDN given the rumen ammonia values and may indicate low degradability of the grain protein from both sources under these circumstances. By assuming a microbial protein yield of 130gMCP/kgDOM then the RDP requirement of the formulated rations is ca. 91 and 98g RDP/kg DM for barley and wheat, respectively. Barley provided ca 82 and wheat ca 91g RDP/kg DM if a value of 70% protein degradability is assumed (Barneveld, 1999) and this nearly meets the requirement and would not explain the low efficiency of microbial protein production from both diets. The estimated N:S was 15:1 which might contribute to this value. Wheat had a higher rumen ammonia N at 3 hrs post feeding (122 vs 147mg ammonia N/L), but the difference is biologically small. The important point is that there are no significant differences in MCP production between both grain sources.

Table 3. The rumen ammonia concentration (mg ammonia N/L) and volatile fatty acid (VFA) (total and molar %) at 3 and 24h after offering the daily ration. Different alphabetical notation within a row denotes a significant difference, P<0.05.

	Barley		Wheat	
Time	3h	24h	3h	24h
Ammonia N	122	112	147	74
(SE)	(4.2)a	(30.2)	(4.7)b	(10.2)
Total VFA mM	66	28	53	32
(SE)	(7.7)	(3.4)	(4.4)	(7.5)
VFA molar %				
Acetic	63.6	57.2	60.0	59.1
Propionic	31.0	24.9	28.3	31.4
Butyric	3.2	10.6	8.1	5.8
Isobutyric	0.7	2.4	1.0	1.4
Valeric	0.7	1.7	1.2	1.3
Isovaleric	0.8	3.2	1.3	1.5

The VFA patterns follow the expected values for a high grain ration for both grain sources with a high proportion of propionate (24-31% molar percentage) and no major significant differences. The only differences were isobutyric and isovaleric at 24 hrs, but the quantitative values are low and biologically of little significance.

The pH of the urine was basic and within the expected range indicating that acid/base balance was not a problem for both diets.

Crude protein digestibility was similar for both grains at 70% and within the expected range. The N balance was also not significantly different between treatments (Table 2), further indicating the similar nutritional value of both grains.

It may be concluded that the new wheat cultivar, Seri 82-Aus, has a digestibility value and other nutritional characteristics similar to collated values in the literature for wheat.

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